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ABSTRACT

This paper is a preliminary report of a pilot study done at the University of Northern Colorado in 1984 using PHOENIX, a mainframe computer based education (CBE) system in a teacher education program. The study deals with the instructional tutorial and a computer based test generation system related to those tutorials. Data on the physiological and psychological factors related to CBE were obtained from 77 students in an educational technology and instructional design program for teachers. Information on the perceived value of computer based education (CBE) by students and achievement gains contributed by CBE are also reported. Brief descriptions of time, terminal availability, lesson format, screen displays, and learning outcomes are discussed. Both tutorial and testing programs were involved in the study. An on-going study which is underway will add to this database with an estimated 1,000 students over 11 courses in 4 subject matter areas. (Author/THC)

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EFFECTIVENESS OF PHOENIX AS A COMPUTER BASED EDUCATION SYSTEM

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Abstract

This paper summarizes a research study completed for the PHOENIX Computer Based Education System in a Teacher Education Program. Information on the perceived value of CBE by students and achievement gains contributed by CBE are reported. Brief descriptions of time, terminal availability, lesson format, screen displays and learning outcomes are discussed. Both tutorial and testing programs were involved in the study. Information on the physiological and psychological factors related to CBE were obtained from the 77 students in an educational technology and instructional design program for teachers.

Introduction

The utilization of computers in the Educational System is being accepted by most educators. There is still some doubt, however, about the educational effectiveness of such instruction. This paper is a preliminary report of a staff study being done at the University of Northern Colorado using PHOENIX, A mainframe delivery system, distributed by Goal Systems, Inc. of Columbus, Ohio.

Although several types of computer application are found in the field of education, (simulation, drill and practice, games, tutorial and testing, etc.), this study deals specifically with the instructional tutorial and a computer based test generation system related to those tutorials. This is a preliminary report of a staff study covering an academic year of coursework. Completion of the final study is scheduled for the end of summer of 1985.

Data in this report were obtained from a pilot study during the summer of 1984 from two classes with a total enrollment of 77 students. An on-going study is underway which will add to this data base with an estimated 1000 students over 11 courses in 4 subject matter areas.

In the research process for the pilot study, no attempt was made to create or establish experimental and control groups or to objectively evaluate the academic capabilities of those

students participating in the study. The preliminary pilot study was descriptive in nature and designed to validate the tutorials and to evaluate the data collection system. The information was obtained from archive files created by the computer as students took lessons and tests. Demographic and attitudinal data were obtained from an evaluation form designed to look at the human factors of computer based education. Separate data exists for each course and for each program (CAI instruction and CMI tests files). This report is an accumulation of data from two courses in two types of computer application.

Population of the study

The persons involved in the pilot study were graduate students in Educational Technology at the University of Northern Colorado. The population consisted of 36 male and 41 female students. Approximately ninety percent were classroom teachers or educational administrators. The rest were full time graduate students, librarians or persons interested in computer operation or application in the public schools. The average age was 35.4 years.

The program

Two courses were used in the pilot study. The first was a Digital/microprocessor theory/lab course consisting of 8 CAI tutorial lessons and parallel test files. The second was an

Introductory Computer Based Education course which consisted of 9 CAI tutorial lessons and parallel test files. The digital course covered information from Basic Gates to microprocessor systems and provided 30 contact hours of laboratory instruction and 20 contact hours of class presentation or discussion. The CBE class included a brief presentation of material on computer structure, types of computer programming language and a brief overview of the basic language. This class was primarily a 30 contact hour lecture class with open labs provided for those who wished to have practice time using the microcomputers available. In both classes, the CAI tutorial lessons were used as an adjunct to the traditional lecture and were designed to be used as either supplemental or initial contact presentations, whichever the student chose. In all cases, for the pilot study the students were given the option of testing prior to or after instruction. In the actual study, pre-testing was mandatory prior to instruction so net achievement/and instruction gain/time could be computed.

Findings of the study

Net worth or value: the first judgement made about the pilot study was that both CAI (instruction) and CMI (testing) were very beneficial to learning the materials. Eighty-six percent indicated that the CMI test and CAI instruction were very worthwhile and contributed much to their learning.

Although some students indicated being a bit uneasy with the PHOENIX terminals at first, over 88% said using the system was easy to learn and presented them with no problems. This supported previous research regarding hardware operation and student attitudes toward the computer. (Kulik, 1983A, 1983B).

Time on the System

The average lesson was designed to take about 45 minutes to complete and the average test, 15 minutes. When asked to estimate how much time they spent on each lesson and test, the students agreed with the time factor. What was not expected, however, was the number of students who took the tests and lessons a number of times. Most doubled the estimated time by repeating the programs until they had mastered the material. The range was from one hour per lesson to a maximum of four hours per lesson. By not restricting access time to the system for either the lessons or the tests, a user back-up did occur. Most students complained about not having access to the terminal when they wanted it. By not scheduling student times, freedom of system access doubled estimated system usage on the average for each student.

Lesson Format and Screen Displays

The screens for the tutorial lessons were restricted to 40-45 character width with 2-3 paragraph limitations. The narrow display (1/2 the available space) made reading easier by

limiting eye movement and provided for more student interaction from the terminal. Almost without exception, the students thought the narrow screen layout, use of highlighting and frequent response requirements helped maintain interest in the program and thus improve its effectiveness. Although sound, graphics and animation were not available for PHOENIX in this study, students still agreed on the usefulness and value of the lessons without those enhancements.

Each lesson was structured in accordance with the PHOENIX format. Lesson titles, descriptions, objectives, clarifications and instructional items were organized for presentation. The educational model followed (Jelden, 1981, 1982) was judged very helpful and provided for remedial as well as accelerated learning. The pacing of the lesson was determined by the operator from the keyboard. When asked if the system of presentation was any better than a textbook for learning, 86% said it was very beneficial and judged it better than a traditional text.

Learning Outcomes

The goal of any educational process is to expand the students' knowledge skill and attitude in a given area. As part of the pilot study, students were asked to judge several things about the system and how it contributed toward their learning experience. Ninety-seven percent of those in the

study rated the computer based education program as very beneficial or contributing factor in achieving the objectives for the course. When asked if the CAI lessons helped them remember the material better than reading it in a text or listening in a lecture 8? percent preferred the CAI lesson. In reading the comments of students, many indicated that interacting with the lesson and being forced to make a decision within the lesson was the contributing factor. This supports the educational concept that students learn and remember material better in an active rather than passive mode (Andresky, 1983; Ortman, 1983). The ability to decide on an item and then receive either remediation for a wrong answer or praise and support for a correct answer seemed to make learning activities more meaningful and thus more productive.

Eighty-one percent of the students in the study indicated that they felt the PHOENIX CBE system helped them learn more material than would have been possible with traditional instruction. Nine percent said it was about the same as traditional instruction. Not one indicated the CBE was a detriment to learning or that it held them back. When asked if the system should be kept and included as part of the instruction program, 99 percent said that it should be retained and incorporated as much as feasible in all classes, with 69 percent saying it should be required for all students. This is

compatible with existing research findings (Broussard, 1983; Baldwin, 1983; and Metrics Associates, 1981).

Testing

Because testing can be performed on individual demand by the students with computer managed instruction, they were asked to list their preferences for test administration. Sixteen percent opted for teacher administered tests at the end of the quarter, 56 percent asked to have tests available on student demand and 18 percent voiced no opinion and indicated that either would be OK. In general 97 percent of the students in the study said the PHOENIX CBE system was very beneficial and rated the option of taking tests several times a contributing factor to their improved learning. It should be pointed out here that the system contained twice as many test items in the data file than was generated on each students exam. Also, test items were randomly presented to the students from this file by objective and difficulty level. This meant that no student received the same test on any retake. The record for test tries in the study was an average of 13 per lesson, with one student taking 110 tests over the 8 lesson series. The class average was 3.8 or about four tries per lesson to achieve mastery which was set at 85%. It should be noted that one try was a pre-test which was used to evaluate student performance prior to instruction. Thus, students averaged about three

post-tests after instruction. To achieve mastery or satisfaction from their point of view. If students did reach the mastery level of 85% on the first post-test try, they could continue to take the tests as many times as they wished if they wanted to raise that mastery level toward 100%, which many did. With the time threat removed, students were less apprehensive about the testing process. (Kulik, 1983C).

Physiological Factors

Students were asked to respond to certain items in an attempt to evaluate the physical effects which CBE might create, such things as eye strain, the environment, time of study and response time were evaluated in this manner.

Thirty-nine percent of the students did indicate some eye fatigue during the testing/instruction period. Comments from several students indicated this was a problem only after prolonged periods at the terminal. A session of from 30 to 45 minutes exposure was not detrimental and posed no major problem. Screen reflection from back or overhead lights did interfere with the ease of reading for materials displayed on the video screen. One interesting point made by the students was that by using PHOENIX, 43 percent felt they spent more time studying the course than they would have if it were presented in the traditional manner. Although no attempt was made to measure the time/mastery function of CBE in this study,

students did raise their level of competence as measured by objective test scores administered at the end of the course. Also, 37 percent said they spent less time studying when they used PHOENIX and still reached a level of competence beyond that expected with traditional instruction. Basically, the utilization of CBE makes provision for both the rapid and remedial learner and can provide educationally sound and meaningful experiences for students at different aptitude levels. The time spent by each student to attain the prescribed levels of competence is determined by the students rather than clock/credit hours. Other research supports the reduction in learning time with CBE (Burns, 1983; Myers, 1983; and Meyer, 1983).

Psychological Factors

The last major phase of the study dealt with the attitude of students toward the CBE system and toward learning on the system. Students were asked to rate their feelings toward CBE and the effective use of their time. Ninety-seven percent indicated that CBE was good utilization of their time and that time spent on the system was more productive that spent in traditional instruction. Seventy-eight percent felt the personalization of the programs, the records and reports generated on their status as they moved through the materials was very good. Some concern was raised by students who said at

some time during the course, they did feel a bit threatened by the computer. Forty-five percent had this feeling at sometime during the quarter but by the quarters end, 95 percent said that it was no major problem to them in achieving the course objectives. Related to this, 95 percent of the respondents said they liked to take lessons and tests on the system and felt good about the educational worth of the experience. This was also supported by previous research (Davis, 1982).

In the open comment section of the evaluation instrument, students provided the following positive and negative observations of the system. These following observations are rated in priority by frequency of occurrence.

Positive Observations

Less anxiety toward learning --- more fun

PHOENIX enhanced my learning experience

Enjoyed learning the content more with PHOENIX

The CAI prepared me well for the exams

Liked the control of pacing my own learning experience

Removed the guesswork from learning by providing objective specific objectives

Liked the ability to upgrade tests with the opportunity for many sessions

Excellent system for reviewing course material once instruction was given

Negative Observations

Terminal availability was a problem

Response time was too long in some instances (computer load was heavy)

Had some eye problem in extended sessions

Conclusions

Based on the results of the pilot study and from the records housed in the computer data bank for lesson and test files, the following conclusions about the instruction/test programs and PHOENIX can be made.

1. Students spent an average of 16 minutes per lesson test and 90 minutes per lesson tutorial.
2. The student to terminal ratio of 12:1 was sufficient for most CAI/CMI applications. This is based on an 8 lesson, 10 week structure with lessons and test averaging about 1.75 to 2.00 hours per unit.
3. Graduate level and adult learners, both men and women, did well in achieving the course objectives and had a positive attitude toward computer basic learning.

4. The CBE system worked equally well for teaching basic content information in lab type activity courses and for traditional lecture type courses.
5. Computer based education was judged very beneficial when used as an ajunct or support system to traditional instruction.
6. Student control over pacing of the lesson and time spent in the lessons is crucial to the development of a positive attitude toward C.B.E.
7. Keeping screen text displays reasonably narrow (40-50 characters) and limiting the amount of information displayed to single concepts or statements provided for more interaction between the system and student thus holding student interest and improving learning.
8. For adult learners, instructional lessons which were generated according to some logical validated educational model proved to be effective. Preparing quality CAI materials is a complex task but can be learned in a reasonable period of time.
9. The PHOENIX CBE system is an effective delivery system when judged by the students' attitudes toward it and as evaluated by final exam test scores over the objectives of the course.

The utilization of the computer as an interactive instruction system in higher education has support both from previous research and from the preliminary results of this study. Discussion with students in the courses involved did raise some social/psychological questions regarding CAI delivery. Some indicated they were programmed rather than taught. This issue has also been raised in other publications (Wiesler, 1984) and will need to be addressed in future research. As of now, CBE is taking its place as an accepted mode of instruction which appears to work best as an adjunct to traditional instruction systems.

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